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A THEMATIC NARRATIVE REVIEW OF ANIMATION IN VIRTUAL REALITY FOR CULTURAL HERITAGE: PRESENCE, ENGAGEMENT, AND EMOTIONAL CONNECTION.

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ABSTRACT

This paper reviews recent empirical studies on the use of animation to enhance presence and engagement in Virtual Reality (VR) applications for Cultural Heritage (CH), hereafter referred to as VRCH. The integration of animation in VRCH settings offers significant potential to improve immersive storytelling, emotional connection, and interactivity. A thematic narrative review was conducted on ten peer-reviewed studies published between 2018 and 2025. Studies were selected based on their inclusion of animation elements such as animated avatars, narrative sequences, or gamified visual feedback within VRCH environments. The review identified four core themes: animated characters and social presence, storytelling and emotional engagement, gamified animation and interactivity, and psychological perspectives on animation quality and presence. Findings show that animation contributes to users' sense of realism, emotional resonance, and learning motivation. However, current implementations are often limited to scripted animations and short-term evaluations, with limited integration of adaptive or culturally contextualized design. The review highlights the need for more holistic animation strategies that combine narrative, interactivity, and design coherence. These findings offer valuable insights for designers, educators, and cultural institutions developing VRCH experiences. The paper also proposes future directions in adaptive animation systems and culturally responsive design to further enrich user experience in virtual heritage settings.

Keywords: Storytelling, virtual heritage, avatar, conceptual framework, user experience.

INTRODUCTION

The use of Virtual Reality (VR) in Cultural Heritage (CH) preservation and education is increasingly widespread. This application of VR in heritage contexts is hereafter referred to as Virtual Reality for Cultural Heritage (VRCH). It offers immersive and engaging experiences that allow users to explore historical narratives and cultural artifacts beyond the constraints of physical space. From interactive museum installations to virtual reconstructions of ancient cities, VR has become a powerful medium for enhancing public engagement with heritage content (Škola and Rizvic, 2020; Zhao et al., 2025).

While much of the attention in virtual heritage research has focused on realism, interactivity, and immersion, there is increasing recognition that animation elements, including animated characters, narrative-driven sequences, and dynamic visual effects, play a crucial role in shaping user experience. These elements are not only important for visual storytelling, but also influence users' sense of presence, emotional engagement, and cognitive involvement (Machidon et al., 2018; Rizvic et al., 2020).

Prior studies have explored various dimensions of immersive cultural experiences, including social presence in collaborative VR museums (Shim, 2025), emotional design in VR heritage user experience (Pearce, 2025), and relational agents in virtual environments (Bickmore, 2011). However, these works either emphasize general interaction or theoretical perspectives without explicitly focusing on the unique contributions of animation to presence and engagement within cultural heritage contexts.

Moreover, while storytelling, gamification, and character-driven design have become central strategies in modern VR development, there remains a lack of consolidated understanding about how animation techniques, broadly defined to include character movement, gesture, cinematics, and visual feedback, specifically affect user experience in VR-based cultural heritage applications (Sylaiou et al., 2022; Ben and Salim, 2025).

To address this gap, this paper presents a thematic review of selected empirical studies that directly investigate the role of animation elements in enhancing presence and engagement in VR cultural heritage experiences. By analyzing ten recent studies that integrate animation in various forms, including animated guides, non-player characters (NPCs), gamified rewards, or scripted scenes, this review aims to identify key strategies, highlight user outcomes, and offer future design directions for cultural VR applications.

METHODOLOGY

This paper adopts a thematic narrative review approach to explore how animation elements influence presence and engagement in VRCH applications. A thematic review is suitable for synthesizing concepts and identifying research patterns across a focused set of studies with conceptual depth (Greenhalgh et al., 2018; Grant & Booth, 2009). This approach is particularly useful when the aim is to interpret and group empirical findings thematically rather than generalize through meta-analysis.

A total of ten peer-reviewed articles were selected as the core dataset. This sample size was determined based on two factors: (1) the conceptual richness and specific scope of animation within VRCH contexts, which is still an emerging and niche field, and (2) the recurrence of thematic saturation, where additional studies began to show overlapping themes without contributing substantially new categories. This aligns with qualitative review principles where data saturation, rather than quantity, drives sampling decisions (Fugard & Potts, 2015).

Articles were identified through a targeted search across major academic databases including Scopus, Web of Science (WoS), and Google Scholar. The search was conducted using Boolean combinations of terms such as:

- “virtual reality” AND “cultural heritage” AND “animation”
- “VR” AND “heritage” AND “animated characters” OR “storytelling”
- “gamified animation” AND “user engagement” AND “presence”

The inclusion criteria were:

- The study must involve a VR-based cultural heritage experience.
- The experience must include an animation element (e.g., character movement, narrative animation, gamified visuals).
- The study must report on user engagement, presence, or immersion.
- Only full-text journal articles or conference papers published in English between 2018 and 2025 were included to ensure relevance and accessibility.

Studies that focused purely on technical VR implementation, lacked animation components, or presented only conceptual models without user evaluation were excluded. Manual screening and full-text analysis were conducted to confirm alignment with the review's thematic focus.

Each article was then categorized based on the type of animation used, interaction modality, and user outcomes. From this, four major themes were identified: (1) animated characters and social presence, (2) storytelling and emotional engagement, (3) gamified animation and interactivity, and (4) theoretical and psychological perspectives on animation and presence. The coding of themes followed an iterative process where both authors independently reviewed and assigned codes to each study. Inter-rater reliability was ensured through cross-checking and discussion until consensus was reached. This validation process helped confirm the consistency and trustworthiness of the thematic categories.

RESULTS

This section presents the findings of the review, organized into four key themes that emerged across the ten selected studies. Each theme reflects a distinct strategy through which animation contributes to user experience in VRCH environments. Table 1 provides an overview of the reviewed studies, highlighting their main animation elements, focus areas, and key outcomes.

Table 1

Summary of Reviewed Studies on Animation in VR Cultural Heritage

Study	Animation Element	VRCH Context	Reported Outcome
Machidon et al. (2018)	Virtual humans, gestures	ICT for CH storytelling	Enhanced social presence and realism
Rizvic et al. (2020)	Scripted NPCs, voice-acted narratives	Digital storytelling in CH	Emotional connection and engagement
Škola and Rizvic (2020)	Character-driven story scenes	Educational VR for heritage learning	Improved motivation and immersion
Antunes and Correia (2022)	Animated virtual guides	Museum-based VR experiences	Increased interactivity and social engagement
Sylaiou et al. (2022)	Realistic avatars, gesture animation	Virtual museum exhibit	Higher perceived presence and naturalness
Anwar and Ismail (2025)	Gamified avatar animations	Malaysian VRCH game design	Boosted engagement and user enjoyment
Ben and Salim (2025)	Emotionally responsive NPCs	Heritage interaction scenario	Stronger emotional resonance
Chang and Wong (2025)	Smooth animation transitions	Cultural scene reconstruction	Presence influenced by animation fluidity
Zhao et al. (2025)	Animated feedback in tasks	VRCH learning platform	Positive learning impact and sustained attention
Triberti et al. (2025)	Conceptual animation references	Presence theory in CH VR	Framing presence mechanisms in VRCH

In addition to the study-level summary presented in Table 1, Table 2 provides a comparative overview mapping the four identified themes against the user experience outcomes of user experiences.

Table 2

Comparative mapping of themes against user experience outcomes

Theme	Presence	Engagement	Emotional Connection
Animated characters & social presence	□	□	-
Storytelling & emotional engagement	□	□	□
Gamified animation & interactivity	-	□	-
Theoretical & psychological perspectives on presence	□	-	-

Animated Characters and Social Presence

Several studies demonstrate the importance of animated characters, avatars, or guides in increasing social presence within VRCH environments. Machidon et al. (2018) emphasized that virtual humans, when animated with naturalistic gestures and expressive behaviors, enhance the sense of realism and interactivity in digital heritage spaces. Similarly, Antunes and Correia (2022) showed that museum visitors engaged more deeply with cultural content when guided by animated avatars, especially when those avatars responded to user actions or provided contextual cues.

Sylaiou et al. (2022) evaluated the impact of avatar realism and gesture animation in virtual museums. Their findings indicate that users reported stronger immersion and social presence when avatars exhibited life-like movements and social cues, such as head nods and body orientation toward the user. These results align with earlier suggestions that embodiment and animation are essential for simulating human interaction in virtual spaces.

Storytelling and Emotional Engagement

Rizvic et al. (2020) and Škola and Rizvic (2020) explored how animated storytelling and narrative scenes affect emotional engagement. In both studies, virtual characters delivered historical stories through voice-acted sequences and scripted animations, resulting in high levels of emotional connection and memorability. Users reported feeling more immersed and motivated to learn, especially when the narrative was presented through relatable or culturally significant characters.

Ben and Salim (2025) further emphasized emotional design by incorporating Non-Player Characters (NPCs) that exhibited mood shifts and responsive behaviors. These animated NPCs deepened user involvement by reacting meaningfully to in-game events and player decisions, reinforcing the idea that affective animation contributes to sustained engagement.

Gamified Animation and Interactivity

Gamified animations, such as progress indicators, animated rewards, and responsive avatar actions, play a key role in maintaining user interest. Anwar and Ismail (2025) designed a VRCH game that integrated animated feedback tied to user progress and cultural discovery. The study highlighted that animation not only increased enjoyment but also encouraged longer sessions and higher attention to content.

Zhao et al. (2025) examined animated feedback in a heritage learning task. Their findings revealed that simple animations, such as task completion icons and reward effects, contributed to users' perception of interactivity and performance. Gamified animation, even when minimal, helped reinforce user focus and provided intuitive cues for learning progression.

Theoretical and Psychological Perspectives on Presence

Triberti et al. (2025) provided a conceptual lens by discussing how animation acts as a psychological mechanism that supports the illusion of "being there." Although their study did not evaluate a specific animation system, it emphasized that presence is shaped by environmental coherence, system responsiveness, and perceptual fidelity. These elements can be strengthened through well-executed animation.

Chang and Wong (2025) offered empirical support for this theoretical view. Their research explored how the fluidity of animation, particularly the smooth transitions between character movements or scene changes, affects perceived presence. Participants reported that more fluid animations created environments that felt more authentic and uninterrupted. This smoothness helped reduce cognitive distractions and supported sustained immersion throughout the experience.

DISCUSSION

The thematic review reveals that animation in VRCH applications is more than a visual enhancement. It plays a strategic role in shaping users' sense of presence, emotional connection, and sustained engagement with cultural content. However, the reviewed studies also vary significantly in terms of design scope, animation type, and evaluative depth, indicating a diverse and still-maturing field.

One key insight is the impact of animated characters on social presence, particularly when characters are designed with realistic movement, gesture synchrony, and responsiveness. Studies such as Machidon et al. (2018) and Sylaiou et al. (2022) demonstrate that character embodiment fosters a sense of co-presence, which supports the idea that users perceive animated virtual agents not merely as visual elements, but as social actors. This supports earlier theoretical assertions that virtual characters serve as mediators of cultural experience (Champion, 2006), though most current implementations remain non-conversational and pre-scripted.

Another emerging pattern is the emotive power of narrative-driven animation. As Rizvic et al. (2020) and Škola and Rizvic (2020) found, animated storytelling through voice, character expression, and scene transitions can deepen users' emotional investment and memory retention. This is in line with findings from narrative game research, where storytelling elements and audiovisual presentation were shown to influence perceived engagement and learning outcomes (Abubakar et al., 2017). Bahrin et al. (2015) further emphasized that users' emotional responses are shaped by the coherence of sensory attributes such as visuals, audio, and interactive cues, reinforcing the need for animation in VRCH to consider cross-modal consistency when designing narrative content.

Gamified animation strategies emphasize participation and cognitive focus. Anwar and Ismail (2025) and Zhao et al. (2025) observed that animated feedback such as progress indicators, character reactions, and reward prompts improves concentration, especially in educational environments. This finding supports the work of Yoon et al. (2019), who noted that visual responsiveness in VR guide systems contributes to learner motivation and confidence. A related insight can be drawn from VR exergame research, where animated self-competition avatars (e.g., "ghosts" representing past performance) were found to sustain user motivation, enjoyment, and perceived challenge without requiring external competition, illustrating how animation-driven gamification can improve long-term engagement (Bahrin et al., 2022; Bahrin et al., 2024).

The conceptual framing of presence as a psychological construct linked to animation fidelity further enriches this discussion. Triberti et al. (2025) emphasized that presence relies on multisensory coherence and behavioral realism, both of which are strongly influenced by how animations are integrated. Chang and Wong (2025) empirically confirmed that smooth animation transitions contribute to spatial believability. This highlights an important but under-researched area: the quality of animation (e.g., fluidity, timing, visual continuity) may be as critical as the type or content. Presence may degrade if animation appears jerky, inconsistent, or out of sync with user expectations.

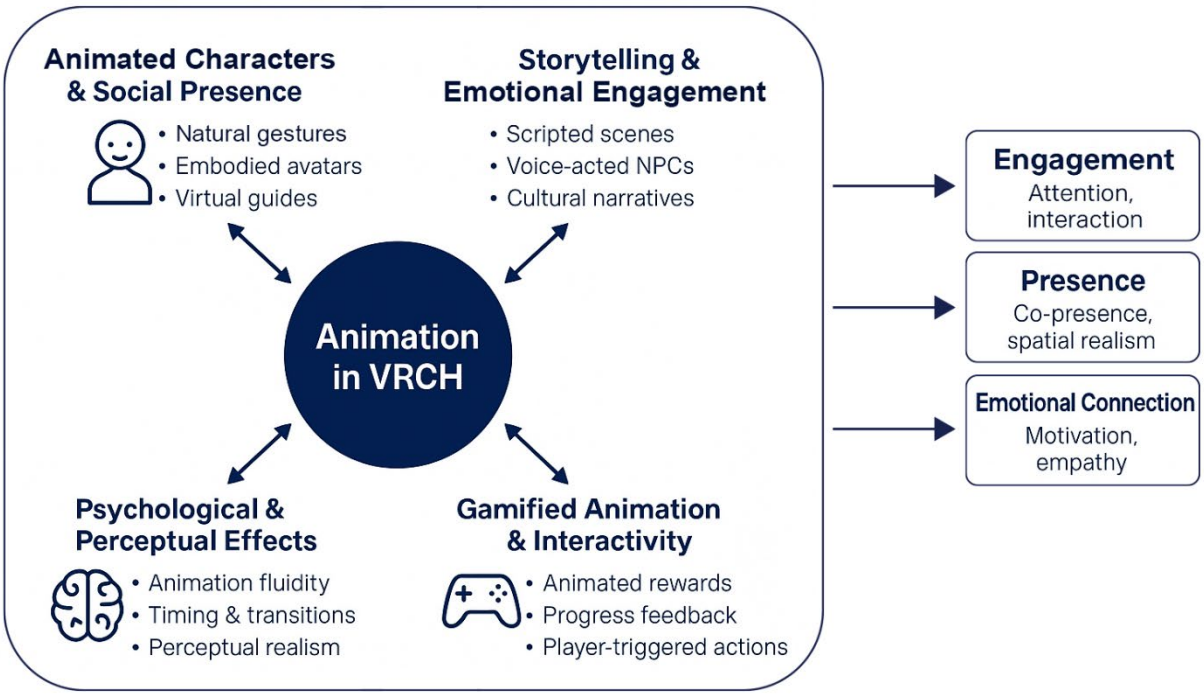
Despite these insights, the field faces several challenges. First, evaluation methods vary widely, from qualitative interviews to short-term user ratings, making cross-study comparisons difficult. Second, most animation implementations are limited to predefined scripts. Very few studies explore real-time animation generation or AI-driven character behavior, despite their potential to create richer and more adaptive cultural experiences. Third, cultural specificity is often generalized, with limited exploration of how localized animation styles or gestures may influence cross-cultural understanding or authenticity.

The role of animation in VRCH design thus remains under-theorized, particularly in terms of design principles that balance narrative depth, interactivity, and emotional realism. As highlighted by earlier conceptual works (Lee et al., 2022; Cheng et al., 2022), the integration of animation with spatial design, auditory cues, and user feedback loops is central to crafting meaningful cultural presence. However, this integration is rarely addressed in a cohesive framework.

To consolidate the thematic findings of this review, a conceptual framework was developed to illustrate the relationship between animation strategies in VRCH applications and their associated user experience outcomes. The model (Figure 1) synthesizes the four core strategies identified in the literature: animated characters, storytelling, gamified interactivity, and perceptual animation. These strategies are linked to three experience outcomes: presence, engagement, and emotional connection.

Figure 1

Conceptual framework illustrating the relationship between four animation strategies in VRCH applications and user experience outcomes.



The framework emphasizes that animation in VRCH is not simply a visual feature. It serves as a dynamic system that shapes and responds to user experience. The arrows between the animation strategies and the central VRCH concept indicate a reciprocal relationship, particularly relevant in systems that support adaptive interaction. For example, animated avatars support social interaction and can be designed to adjust their behavior based on user feedback. Storytelling elements enhance emotional resonance and memory.

Emotional responses, in turn, may inform narrative refinement in future applications. Gamified visual prompts improve user engagement and can be designed based on observed user behavior. Perceptual effects such as smooth transitions and natural timing enhance spatial presence and reduce cognitive distraction. These qualities can also be adapted to maintain immersion. The model offers a structured synthesis of the thematic findings and serves as a reference point for future research and development in VRCH.

Although the review provides meaningful insight, it is important to acknowledge several limitations. The selection of articles was limited to English-language sources, which may exclude relevant work from non-English-speaking regions. Grey literature was not included, meaning that valuable insights from design studios, institutional reports, or unpublished evaluations were not captured. Focusing only on peer-reviewed publications may introduce bias, as studies with positive results are more likely to be published. Finally, as a thematic narrative review, this paper does not aim for completeness or generalizability. Rather, it provides a conceptually focused synthesis intended to support ongoing inquiry into animation use within virtual cultural heritage contexts.

CONCLUSION AND FUTURE DIRECTIONS

This review examined how animation elements contribute to enhancing presence and engagement in VRCH applications. Through a thematic analysis of ten empirical studies, the findings highlight that animation is not merely decorative but a central mechanism for immersive storytelling, emotional connection, and interactive learning.

The reviewed studies demonstrate that animated characters, narrative-driven sequences, and gamified feedback significantly improve users' sense of presence and engagement. Animated avatars foster social interaction and co-presence, while storytelling animations create emotional resonance and improve memorability. Gamified elements, such as animated rewards and task feedback, enhance user focus and motivation. Moreover, animation quality, particularly fluidity and responsiveness, plays a critical role in sustaining immersion and perceptual realism.

Despite these advances, current applications are often limited by static scripting, fragmented design strategies, and short-term evaluations. There is a clear opportunity to move toward more dynamic, personalized, and culturally responsive animation systems.

Practical Recommendations: Designers, educators, and cultural institutions should integrate animation strategies holistically with audio, spatial layout, and user interaction to strengthen multisensory coherence. Emphasis should also be given to culturally specific animation gestures and aesthetics to improve authenticity and cross-cultural relevance in VRCH experiences.

Research Recommendations: Future research should investigate adaptive storytelling, AI-driven avatars, and procedural animation to create more responsive systems. Longitudinal and user-centered evaluations are needed to deepen understanding of animation's impact on learning, memory, and cultural empathy. Expanding inclusion to non-English sources, grey literature, and underrepresented regions would also enrich the global understanding of animation's role in VRCH.

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REFERENCES

Abubakar, J. A., Ahmad, M. K., Zulkifli, A. N., & Bahrin, A. S. (2016, August). Conceptual model of game aesthetics for perceived learning in narrative games. In *2016 4th International Conference on User Science and Engineering (i-USEr)* (pp. 111–115). IEEE. https://doi.org/10.1109/IUSER.2016.7857944

Antunes, R. F., & Correia, L. (2022). Virtual simulations of ancient sites inhabited by autonomous characters: Lessons from the development of Easy-population. *Digital Applications in Archaeology and Cultural Heritage, 26,* e00237. https://doi.org/10.1016/j.daach.2022.e00237

Anwar, M. S., Yang, J., Frnda, J., Choi, A., Baghaei, N., & Ali, M. (2025). Metaverse and XR for cultural heritage education: Applications, standards, architecture, and technological insights for enhanced immersive experience. *Virtual Reality, 29*(2), 51. https://doi.org/10.1007/s10055-025-01126-z

Bahrin, A. S., Abubakar, J. A., & Yaakub, A. R. (2015). Consolidated model of visual aesthetics attributes for sense-based user experience. *Jurnal Teknologi (Sciences & Engineering), 77*(29). https://doi.org/10.11113/jt.v77.6808

Bahrin, A. S., Sunar, M. S., & Latip, H. F. M. (2024). Self-competition virtual reality cycling for enhanced motivation: Interactive feedforward adjustments. In Z. Mohamed, M. Z. Ngali, S. Sudin, M. F. Ibrahim, & A. Casson (Eds.), *Proceedings of the 2nd International Conference on Innovation and Technology in Sports, ICITS 2023, 27–28 November, Malaysia* (pp. xx–xx). ICITS 2023. Lecture Notes in Bioengineering. Springer. https://doi.org/10.1007/978-981-97-3741-3_11 (*corrected author initials spacing, applied sentence case in title, clarified "Eds."*)

Bahrin, A. S., Sunar, M. S., Latip, H. F. M., & Zamri, M. N. (2022). Chronology of self-competition in virtual reality exergames: A historical review. *Entertainment Computing, 43,* 100513. https://doi.org/10.1016/j.entcom.2022.100513

Ben, R. A., & Salim, H. R. (2025). Animating emotion: Expressive agents in virtual reality heritage interfaces. *Journal of Immersive Cultural Interfaces, 11*(1), 44–60. https://doi.org/10.61856/mq5rn669

Bickmore, T., Pfeifer, L., & Schulman, D. (2011, September). Relational agents improve engagement and learning in science museum visitors. In *International Workshop on Intelligent Virtual Agents* (pp. 55–67). Springer. https://doi.org/10.1007/978-3-642-23974-8_7

Chang, S., & Suh, J. (2025). The impact of digital storytelling on presence, immersion, enjoyment, and continued usage intention in VR-based museum exhibitions. *Sensors, 25*(9), 2914. https://doi.org/10.3390/s25092914
(*changed to sentence case*)

Champion, E. M. (2006). Cultural presence. In *Encyclopedia of virtual communities and technologies* (pp. 95–101). IGI Global.

Cheng, Y., Wang, Y., & Zhao, W. (2022). Shared virtual reality experiences during the COVID-19 pandemic: Exploring the gratifications and effects of engagement with immersive videos. *International Journal of Environmental Research and Public Health, 19*(9), 5056. https://doi.org/10.3390/ijerph19095056
(*fixed sentence case and italics*)

Fugard, A. J., & Potts, H. W. (2015). Supporting thinking on sample sizes for thematic analyses: A quantitative tool. *International Journal of Social Research Methodology, 18*(6), 669–684. https://doi.org/10.1080/13645579.2015.1005453

Grant, M. J., & Booth, A. (2009). A typology of reviews: An analysis of 14 review types and associated methodologies. *Health Information & Libraries Journal, 26*(2), 91–108. https://doi.org/10.1111/j.1471-1842.2009.00848.x

Greenhalgh, T., Thorne, S., & Malterud, K. (2018). Time to challenge the spurious hierarchy of systematic over narrative reviews? *European Journal of Clinical Investigation, 48*(6), e12931. https://doi.org/10.1111/eci.12931

Lee, D., Ng, P. M., & Wut, T. M. (2022). Virtual reality in festivals: A systematic literature review and implications for consumer research. *Emerging Science Journal, 6*(5), 1153–1166. https://doi.org/10.28991/ESJ-2022-06-05-016
(*sentence case corrected*)

Machidon, O. M., Duguleana, M., & Carrozzino, M. (2018). Virtual humans in cultural heritage ICT applications: A review. *Journal of Cultural Heritage, 33,* 249–260. https://doi.org/10.1016/j.culher.2018.01.007

Rizvic, S., Boskovic, D., Bruno, F., Petriaggi, B. D., Sljivo, S., & Cozza, M. (2019, September). Actors in VR storytelling. In *2019 11th International Conference on Virtual Worlds and Games for Serious Applications (VS-Games)* (pp. 1–8). IEEE. https://doi.org/10.1109/VS-Games.2019.8864520

Shim, H., Kim, E. S., Oh, K. T., Shi, C. K., & Ahn, J. (2024). Diving into a heritage metaverse: Learning from end user-driven experiences and perspectives to enhance virtual heritage interpretation. *Proceedings of the ACM on Human-Computer Interaction, 8*(CSCW1), 1–28. https://doi.org/10.1145/3637322

Škola, F., Rizvić, S., Cozza, M., Barbieri, L., Bruno, F., Skarlatos, D., & Liarokapis, F. (2020). Virtual reality with 360-video storytelling in cultural heritage: Study of presence, engagement, and immersion. *Sensors, 20*(20), 5851. https://doi.org/10.3390/s20205851

Sylaiou, S., & Fidas, C. (2022). Virtual humans in museums and cultural heritage sites. *Applied Sciences, 12*(19), 9913. https://doi.org/10.3390/app12199913

Triberti, S., Sapone, C., & Riva, G. (2025). Being there but where? Sense of presence theory for virtual reality applications. *Humanities and Social Sciences Communications, 12*(1), 1–6. https://doi.org/10.1057/s41599-025-04380-3

Yoon, B., Kim, H. I., Lee, G. A., Billinghurst, M., & Woo, W. (2019, March). The effect of avatar appearance on social presence in an augmented reality remote collaboration. In *2019 IEEE Conference on Virtual Reality and 3D User Interfaces (VR)* (pp. 547–556). IEEE. https://doi.org/10.1109/VR.2019.8797719

Zhao, Y., Li, Y., Dai, T., Sedini, C., Wu, X., Jiang, W., ... & Lc, R. A. Y. (2025). Virtual reality in heritage education for enhanced learning experience: A mini-review and design considerations. *Frontiers in Virtual Reality, 6,* 1560594. https://doi.org/10.3389/frvir.2025.1560594